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bud there is fission, but no blending. The cells divide, and each new one may in turn divide until the ultimate form of the leafy branch or flower is reached. In the leafy branch new buds form, and in their turn carry forward the ancestral peculiarities. But in the flower, on the other hand, with the formation of the ovule, all development is arrested (except in the rare cases of parthenogenesis and the like) unless the protoplasm of the embryonal sac receives a new impetus from material contributed by the pollen grain. And in this blending of parts which have developed under different external conditions, we see that there is a chance for variation to come in. Not only is there a blending of the nuclei, but a sharing of the accompanying trophoplasts. How this can be applied to the lower plants and other organisms can not now be referred to. It would not be right to hold de Vries wholly responsible for the application just given, but I ask you whether the hypothesis does not appear fruitful. It seems likely to stimulate speculation and further research in this important field.

In view of de Vries' work, and of the results of recent study, which I have endeavored to bring before you this afternoon, does not the statement of Darwin possess new force?

"An organic being is a microcosm, a little universe formed of a host of self-propagating organisms inconceivably minute and as numerous as the stars in heaven."

Cambridge, Mass.

Paraguay and its flora. II.

THOMAS MORONG.

It would be out of place in an article like this for me to attempt to enumerate even a tithe of the trees found in these dense Paraguayan forests, but among those best known abroad are the India-rubber (*Siphonia elastica*), *Erythroxylon Coca*, logwood (*Hæmatoxylon Campechianum*), *Salix Humboldtii*, *Carica Papaya*, *Quillaia saponaria*, *Fabiana imbricata*, *Nectandra*, *Franciscea uniflora*, the Omber (*Pircunia dioica*), and *Juga dulcis*. Something of their character and numbers may be seen in the collection of her woods which Paraguay has sent to the present Exposition at Paris. The collection is in part composed of one made several years since for a similar exhibition at Montevideo, to which large additions have been made by Dr. Emile Hassler, who has

charge of the matter. The specimens, which have been carefully prepared in sections so as to show the bark and the interior fiber of the wood, together with many thin squares polished and framed, number in all 233 different species. To these Dr. Hassler has added specimens of charcoal made of different kinds of wood, 93 specimens of trees, shrubs and herbs which are used for medicinal purposes, 38 that yield textile fabrics, 8 of them furnishing vegetable silk, and 25 from which excellent materials for coloring and dyeing are obtained. Few countries of the size of Paraguay, which scarcely equals the state of Colorado¹ in area, could make such an exhibition. Brazil is probably the only South American country which could surpass this little territory in this respect.

In table supplies Paraguay is hardly surpassed by any nation on the globe. To say nothing of the ordinary garden vegetables, nearly all of which are easily cultivated in her fertile soil, she has of fruits the orange, the lemon and the citron, all growing here to perfection and without culture; the fig, banana, pine-apple, peach, grape, guava, papaw, water-melon and musk-melon, both of fine quality and raised with scarcely any care; the cocoa-nut (that is, the small cocoa-nut mentioned above, which is very edible), peanut, sterculia-nut (similar to cocoa), and many other wild fruits for which there are no popular English names. Of other valuable productions she furnishes the far-famed Yerba-maté (*Ilex Paraguayensis*), a tea drank by eighteen million people in South America, the best and by far the greater part of which grows wild in her eastern Cordilleras; coffee, as good as that of Brazil; cotton, equal to any upland cotton of the United States; tobacco, which is raised in large quantities; mandioca or cassava, regarded with good reason as an excellent substitute for wheat flour; maize or yellow corn, grown abundantly by the farmers; sugar-cane, of the best quality; sorghum, Irish and sweet potatoes and yams, rice, the egg-plant, and many fine pasturage grasses. We must take into the account, too, that this country is agriculturally yet in its infancy. The farming is very limited, and at best of the poorest sort. The conditions are all favorable for raising nearly everything which can be grown in a semi-tropical climate, and I have no doubt that in time scores of other fruits and vegetables will be success-

¹Paraguay has an area of about 100,000 square miles, while Colorado has over 104,000 square miles of territory.

fully introduced from abroad into this well-watered, sunny and fertile land.

The most prolific order of plants found here is, of course, the Compositæ, as it is in all other countries. Many members of the order, however, are shrubs, some even attaining the stature of trees. Others possess a floral structure which is very strange to a botanist from the United States. One of them has four small, inconspicuous, deciduous staminate flowers right in the center of the receptacle, which are surrounded by a row of large achenia surmounted by hooked spines and small corollas, and becoming in fruit sharp-thorned burrs that are a great nuisance. Another large and succulent plant bears along the upper side of its curving stems rows of the most beautiful variegated green and white rosettes, looking as if made in a milliner's shop for a lady's bonnet. Still another species has conglomerate heads, the outer involucre consisting of three large foliaceous scales, and within many separate bundles of heads, each bundle furnished with a set of scales, and each head with its own proper scales. I have found several species which bear these peculiar compound heads. The strangest of all is a composite which has only one sheathing involucre scale. Perhaps, however, as the scale bears five small lobes at the summit, it may be said that five scales have so completely coalesced as to appear only one. This flower runs all to 5's. The involucre has five lobes, and also five rows of curious yellow glands sunk beneath its surface. There are five flowers in the head, five pappus scales, five lobes to the corollas, and five stamens. Besides, it is stipulate; the stipules consisting of three-branched, and sometimes of five-branched hairs. Some of the composites have leaves with a curious margin not described in the books, bearing at intervals lunate indentures or depressions, each with a corresponding brownish lunate gland, sunk below the surface of the leaf, a short distance beneath it.

The Leguminosæ rank next in number to the Compositæ, presenting innumerable species of Acacia, Mimosa, Cassia, Phaseolus, and other genera. Then come the Asclepiadaceæ and Bignoniaceæ, many of which, perhaps the most, are lianas that clamber over shrubs and trees, with conspicuous flowers and fruits. Of the former, two species have interested me exceedingly. They belong to that curious South American genus, the *Araujia*. Some of the readers of the GAZETTE may remember an article in the *American Nat-*

uralist, by E. C. Stearns, which was quoted in the *Popular Science Monthly* for March, 1888, in which the writer describes the moth-catching propensities of *A. albens*, a native of Buenos Ayres. I think that all the species of *Araujia* are moth catchers. At least one of those that I have collected here is so, of which I had an interesting illustration. This species differs a good deal from *A. albens*. It bears axillary clusters of fragrant white flowers, the corollas of which have long segments that are twisted spirally about each other somewhat like the arms of a boy's paper wind-mill. The first time I came across this plant I found a large humming-bird moth imprisoned by a flower, and struggling desperately to get free, but in vain. It had thrust its proboscis into the flower in search of honey and was utterly unable to withdraw it, although a very powerful insect, in fact, as large as one of the smaller humming-birds, which it much resembles. I intended to keep the insect in place, dissect the flower, and ascertain just how it was confined, which I confess I do not understand, notwithstanding the description of Mr. Stearns, but in plucking the flowers I accidentally liberated the moth and so lost the opportunity of investigation. Another species here is a very conspicuous climber, with large, solitary, axillary and fragrant blossoms, and an immense spine-covered fruit almost as large as a cucumber.

The Bignonias are some of them tall trees, and others climbing plants, usually with showy flowers, very long pods, and winged seeds. They generally blossom late in the year, many of them adorning the forests in the winter season. Nearly every thicket abounds with climbers of various kinds, some of which mount to the tops of the tallest trees, choking and finally killing them with their exuberant growth. Indeed, vegetation here is so prolific that it is difficult to penetrate the thickets without a hatchet or axe in hand. Trees and shrubs, vines and runners, crowd into every available foot of space, and one must wind through them like a fox or a squirrel. The shade within is so great that a person can scarcely pick his way along. Fallen trees obstruct the course at every step, and a road or path unused for six months becomes so covered with new growths and decaying logs that it is impassable. Even traveled highways and railroads have to be cleared almost monthly of the vegetation which constantly encroaches upon their borders.

Nor is this the only difficulty which a botanist experiences

in herborizing in Paraguay. If he succeeds in capturing rare botanical treasures, he can not do it without much trouble. He either runs the risk of broken limbs in the attempt to climb high trees, or of sore wounds if he incautiously catches hold of a shrub or a liana. Nearly every arborescent plant is armed with stout, sharp thorns, which tear his clothing and very likely something else more sensitive than cloth. Here is a lovely *Acacia*, with bright yellow blossoms, which I covet, but in an instant it has caught my coat at a dozen points with its keen hooked spines. If I attempt to tear myself away, lo! several great rents in my coat, and unfortunately no fireside companion at hand to make the rents whole again. If I cut off a branch with a jerk of the knife, half a dozen deep gashes in my hand is the result. Here is a beautiful climber, the flowers of which I must have, but in order to get it, not only must I encounter the spears of a host of encircling *Yuccas* and the prickles with which the climber is itself clad, but I must also break through the spiny armor of an *Acacia*, around which the stems have managed to twine themselves so closely that they can scarcely be touched at a single point without a wound. Again, I see a beautiful shrub, of I know not what genus, which bears a large evergreen leaf and handsome clusters of rose-colored *Camellia*-like flowers. I hasten to transfer specimens to my portfolio, but hidden under the bright leaves and charming flowers is a stem bristling at intervals of a few inches with verticils or branching prongs, an inch and a half in length and as sharp as needles, and what is even worse, these needles infuse a poison into the wound which they make and cause it to fester.

Other plants harbor colonies of ants, by which they seem to be benefitted, or, at least, protected, and if you dare invade their premises they resent it instantly and pour forth in angry swarms. Nor is their bite to be despised. I once plucked a stalk of grass from the ground, and before I could place it in my portfolio my hand was covered with small red ants, whose stings burned like hot coals. It was the "fire ant," insignificant enough in looks, but so venomous of sting that every one avoids it. Other colonies climb trees, and with plasters of mud convert old birds' nests into habitations, which it is really quite dangerous to molest except with lighted matches. On another occasion, while leaning down to collect plants, I happened to place my hand against the trunk of a dead tree, but a sharp stinging sensation soon warned me that my hand

was resting upon something besides dead wood. It was the home of a colony of what is called "soldier ants," an insect nearly half an inch long and with a round black head which seems to be one-third the size of its body, and armed with formidable forceps. In a spirit of spitefulness, I took a stick and broke their nest to pieces, and so fierce were the creatures that they attacked my stick viciously, and doubtless would have bitten me to death could they have reached me. Plants which are defended by such ants and also by large red wasps, hornets and spiders, which make their home upon them, are not to be touched with impunity. A wasp whose bower I had entered in search of specimens, stung me so severely that I was glad to retreat with the most unceremonious haste.

Other plants are guarded against mutilation in a different, but perhaps none the less effective, manner. They pour out a copious discharge of acid, milky juice, which sometimes raises a blister upon the skin, and is always unpleasant to encounter. An *Asclepiad* growing near Asuncion, from which I cut branches, discharged such large drops of viscid milk upon my hands and clothing that I wished I had let it alone, and the specimens adhered to the leaves of the portfolio and the sheets of drying paper as though they had been smeared with postage-stamp mucilage. On another occasion, while making my way through a dense wood, I heard a pattering like the falling of rain-drops. As it was a bright, sunshiny day, I was curious to learn the cause of the sound. Upon investigation, I found that it was occasioned by drops of milk, which were falling in a shower from the leaves of a large tree. The ground was quite white with the drops. Many cattle were grazing in the vicinity, but I noticed that they scrupulously avoided this tree, and never browsed upon its leaves, although they ate almost everything else within reach.

The greatest obstacle to the preservation of botanical specimens lies in the excessive humidity of the climate. The atmosphere seems to be loaded with vapor at all times, even in the most cloudless weather. The average annual rainfall at Asuncion, and probably that of Paraguay in general, is about 70 inches. Some scientists estimate it as high as 80 inches.² This year, according to meteorological statistics kept by government, the rainfall has been a little more than 70 inches. With such an amount of humidity in the air, of

² Notes of a Naturalist in South America, by John Ball, p. 299.

course many things will mould in spite of the utmost care. It must be remembered also that the houses are built of brick, one story in height, with brick floors, and entirely without appliances for obtaining artificial heat, so that they are always damp. My books, shoes, leather straps, paper and presses, and even my wearing apparel, are generally more or less moist when not exposed to the sun. Specimens dried in the sun are sure to become damp and limp during the night and in rainy and cloudy weather, which sometimes lasts for several days. Added to this is the natural tendency of many plants to drop to pieces in the process of curing. The new-comer, good easy soul, naturally supposes that, with such a hot sun, his specimens are sure to dry easily and quickly. Experience will soon convince him to the contrary. Take this shrubby *Ipomœa*, which is very common in the lowlands around Asuncion. The flowers are as large and showy as those of a morning-glory. Let the collector place specimens in the best order between his driers, and change them every hour if he chooses. In less than three days he will have the pleasure of seeing flowers, leaves and buds, all disarticulated. I worked over scores of specimens of this plant. I tried every expedient that I could devise, took pains to get young and fresh plants, split the stems in two, exposed them to sun heat; but all in vain. I have never succeeded in preserving over half a dozen specimens in which the leaves or flowers adhered to the stem. Take this pretty little red-flowered papaveraceous plant, and carefully arrange that in your press. In three weeks it is just as juicy as ever, and, still worse, there is nothing left of it but fragments. The floral organs have fallen to pieces, petals, sepals, styles and all, and only *dissecta membra* lie on the paper, leaving a bare stem, and perhaps even that has become dismembered with the rest. Here is a lovely *Commelyna*, which I wish to send home to delight North American eyes. The corolla is large, of a bright azure blue. I put that in press, and in an hour's time look at it. In that short period the petals have apparently been converted into a little pool of water! Like the manufactured thing here which they call *ice*, a piece of which dissolves while you are pouring water into the tumbler, so this charming flower has *melting*! All that is left of the petals when dried is a small, shrivelled, membranous heap which hardly wears the aspect of a flower. The stem and leaves, however, make up for the evanescence of the corolla, for they will keep green and succulent for six weeks under pressure.

Of course, a zealous and persistent botanist will surmount all these difficulties in one manner or another, but it will be seen from my account that it is no easy task to collect and preserve the members of the Paraguayan flora. Begonias, which abound here, and other succulent plants, are exceedingly difficult of management. Some plants, like the Calamus, can not be dried in any decent shape, and others, like the Victoria regia and several of the Cacti, can not be preserved at all. They will mould or rot in despite of every expedient. Many specimens must be preserved, if at all, in fragments, and pieced together upon the mounting paper.

Notwithstanding all this, I have managed to get together about 750 species and some 8,000 specimens, which I trust will be in a sufficiently good condition when they get home to be identified and to make a valuable addition to the herbaria of the United States.

Asuncion, Paraguay.

The grasses of Roane Mountain.

BY F. LAMSON SCRIBNER.¹

Roane Mountain, lying on the border line between Tennessee and North Carolina, has been made famous as the botanizing ground of some of our best botanists, including even Dr. Gray, who first visited it in 1841, and its flora possesses a peculiar as well as a historical interest. In the old register of the hotel are recorded the finds of the several botanists or botanical parties who have visited the locality. The first of these was made in 1878 by Dr. Geo. Vasey, who, under the head of "Grasses of Roane Mountain," enumerates the four or five species observed by him.

As the guest of Mr. C. M. McClung, a prominent business man of Knoxville, Tennessee, and an enthusiastic student of North American plants, I spent a few of the last days of July of the present season upon the mountain, and improved the occasion by investigating the grasses of the locality. As the result of three days' rather diligent search, we together found on or near the mountain summit (all at an elevation of over 6,000 ft. above sea level) twenty-five species, of which the following is a list:²

¹ Read before Section F, at the Toronto meeting of the A. A. S. 1889.

² I have already, in a paper read before the Society for the Promotion of Agricultural Science at the Toronto meeting, considered the grasses of this region from an agricultural aspect.